

# PATENT COOPERATION TREATY

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## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference CH920030021	<b>FOR FURTHER ACTION</b> See Form PCT/IPEA/416	
International application No. PCT/B2004/001379	International filing date (day/month/year) 28.04.2004	Priority date (day/month/year) 03.06.2003
International Patent Classification (IPC) or national classification and IPC H01L51/40		
Applicant INTERNATIONAL BUSINESS MACHINES CORPORATION		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 3 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand  04.04.2005	Date of completion of this report  09.09.2005	
Name and mailing address of the international preliminary examining authority:   European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  Faou, M  Telephone No. +31 70 340-4992 	

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

**Description, Pages**

1-10 as originally filed

**Claims, Numbers**

1-13 received on 06.04.2005 with letter of 01.04.2005

**Drawings, Sheets**

1/3-3/3 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	1-5,11-13
	No: Claims	6-10
Inventive step (IS)	Yes: Claims	1-5,11-13
	No: Claims	6-10
Industrial applicability (IA)	Yes: Claims	1-13
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

Reference is made to the following documents:

- D1: EP-A-1 223 201 (CAREY BROTHERS LTD) 17 July 2002  
D2: KATHERINE DERBYSHIRE: "Are plastics the future of electronics? Semiconductors polymers offer flexibility, low cost, mechanical robustness." SEMICONDUCTOR MAGAZINE, [Online] vol. 3, no. 4, 1 April 2002 (2002-04-01), Retrieved from the Internet: URL: <http://dom.semi.org/web/wmagazine.nsf/0/f65c6d097aeea4be88256b8e0076e255?OpenDocument> [retrieved on 2004-08-10]  
D3: US 2002/083858 A1 (OKUZAKI HIDENORI ET AL) 4 July 2002  
D4: US-A-6 071 333 (BRETON MARCEL P ET AL) 6 June 2000  
D5: WILLIAMS T. ET AL: "Hot Melt Ink Technology for Chrystalline Silicon Solar Cells" INTERNET ARTICLE, [Online] 20 May 2002- 24 May 2002 (2002-05-24) Retrieved from the Internet: URL: <http://www.bpsolar.com/ContentDocuments%5C154%5CACF16E2.pdf> [retrieved on 2004-08-10]

1.

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 6-10 is not new in the sense of Article 33(2) PCT.

Document D4 discloses:

A composition for patterning a surface comprising  
an application material for forming a pattern (colorant yellow, red, example II-VIII, column 19, lines 21-30), and  
a phase-change transfer material ( column 5, lines 36-45, column 8, lines 60-62)  
wherein the application material comprises an organic material (colorant, see examples)

The formulation "that sublimates after patterning by an action" is not clear. Moreover it does not relate to a technical feature of the composition but to a method of treatment of the composition. Therefore this feature does not add anything to the subject-matter of claim 6. All features of claim 6 are therefore disclosed in D4 and the subject-matter of this claim is not new in the sense of Article 33(2) PCT.

D2 describes methods of fabricating organic electronic devices, such as OLEDs or organic transistors, and in particular mentions the solid ink printing technology as a method to deposit organic materials used in these devices (see page 3, manufacturing organic electronics). Solid ink printing is an other name to the phase-change printing technique or the hot-melt ink printing technology.

This technique is a well-known method used in different fields to deposit patterned layers (see D1, page 4, D3, paragraphs 87, 97, 140, 141, D4, D5) and the composition of the ink commonly comprises an application material (which is in the case of OLED, an organic material) and a phase-change transfer material.

Therefore the subject-matter of claim 1 is also not new according to D2.

Additional features of claims 7-10 are also disclosed in D4 (see examples, columns 15-18, column 5, lines 35-43, column 9, line 43) (Article 33(2) PCT).

2.

Document D1, which is an other relevant prior art, discloses:

A method for forming a pattern on a surface by deposition of a mixture that comprises an application material of molecules (chemical dye, paragraph 18, claim 15) and a phase change transfer material (wax), the method comprising the steps of:

- heating the mixture to a melt (paragraph 31)
- depositing the melted mixture on the surface with a phase-change printing technique, thereby the melted mixture solidifies instantaneously when it reaches the surface (paragraph 31) and
- removing the transfer material (paragraph 31) by firing to burn off transfer material (paragraphs 37, 64)

The subject-matter of claim 1 differs from D1 in that the transfer material is removed by sublimation.

The subject-matter of claim 1 is therefore novel (Article 33(2) PCT).

The technical effect caused by this difference is a high resolution patterning, the problem to be solved by this technical feature can therefore be regarded as to improve the technique to remove transfer material.

There is no indication in the prior on how to modify the method as described in D1 to get the

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process as claimed in claim 1.

D5, which refers to the phase-change printing technique wherein a step of removal of the transfer material is performed, also describes the firing technique to burn off the organic transfer material.

The solution to the problem proposed in claim 1 of the present application is therefore considered as involving an inventive step (Article 33(3) PCT).

Consequently the subject-matter of claim 1 meets the requirements of Article 33(1) PCT.

Claims 2-4 are dependent on claim 1 and as such also meet the requirements of the PCT.

Claims 5, 12 and 13 refer to the application of the method mentioned in claim 1 to an OLED and an organic field-effect transistor. Therefore the subject-matter of these claims also meets the requirements of Article 33(1) PCT.

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**CLAIMS**

1. A method for forming a pattern on a surface (10) by deposition of a mixture (20) that comprises an application material of molecules, oligomers, nanoparticles and a combination thereof (22) and a phase-change transfer material (24), the method comprising the steps of:
  - b.) heating the mixture (20) to a melt;
  - c.) depositing the melted mixture (21) on the surface (10) with a phase-change printing technique, thereby the melted mixture (21) solidifies instantaneously when it reaches the surface (10); and
  - d.) removing the transfer material (24) by sublimation.
2. The method according to claim 1 further comprising the step of a.) mixing the application material (22) with the transfer material (24) to the mixture (20).
3. The method according to any one of the preceding claims, wherein the step of removing the transfer material (24) by sublimation comprises applying a low pressure to and/or heating the deposited mixture (20).
4. The method according to any one of the preceding claims comprising repeating the steps b.) to d.) to deposit multiple layers.

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5. A process for fabricating an organic light-emitting device (OLED) comprising the steps of:

heating a composition (20) to a melt (21), the composition (20) comprises an organic material (22) and a phase-change transfer material (24);

depositing the melted composition (21) onto a surface (10) by a phase-change printing technique, thereby the melted composition (21) solidifies instantaneously when it reaches the surface (10); and

removing the transfer material (24) by sublimation whereby the organic material (22) remains on the surface (10).

6. A composition (20) for patterning a surface (10) comprising

an application material (22) for forming a pattern, and

a phase-change transfer material (24) that sublimates after patterning by an action, wherein the application material (22) comprises one of an organic material, an OLED material, biological molecules, nanoparticles, and a combination thereof.

7. The composition according to claim 6 being a mixed powder.

8. The composition according to one of the preceding claims 6 and 7, wherein the transfer material (24) is a solid at approximately 0°C and melts at ambient pressure below 200°C.

9. The composition according to one of the preceding claims 6 to 8, wherein the transfer material (24) comprises cyclododecane or its derivatives.



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10. The composition according to one of the preceding claims 6 to 9, wherein the transfer material (24) comprises one or more components.
11. The method according to claims 1 to 4 used to fabricate one of an organic electronic device, a monochrome and/or color display, a biological pattern, a biochip, a sensor, a semiconductor device, and a circuit.
12. A process for fabricating a field-effect transistor comprising the steps of:
  - forming source and drain contacts (402) on a substrate (400);
  - heating a composition (20) to a melt (21), the composition (20) comprises an organic material (22) and a phase-change transfer material (24);
  - depositing the melted composition (21) onto the substrate (400) with the source and drain contacts (402) by a phase-change printing technique, thereby the melted composition (21) solidifies instantaneously when it reaches the substrate (400);
  - removing the transfer material (24) by sublimation whereby the organic material (22) remains on the surface (10) as an organic semiconducting layer (404);
  - forming an insulating layer (406) on the organic semiconducting layer (404); and
  - forming a gate contact (408) on the insulating layer (406).
13. The process according to claim 12, wherein at least one of the source/drain contacts (402), the insulating layer (406), and the gate contact (408) is created according to the method of claims 1 to 4 by the phase-change printing technique.